Sun♦Lab SnapShot

10-kW Solar Dish/Stirling Remote Power System for Native American Applications

To meet worldwide need for clean, reliable, remote power, we are developing a solar power system using the best of advanced solar dish, Stirling engine, and controls technology developed over the past several years. The first prototype is currently operating successfully at the National Solar Thermal Test Facility in Albuquerque. We expect to field a remote system at a southwest Native American site in early 2001.

Remote power applications provide an opportunity for high-value distributed power (50¢/kWh and higher for some remote applications) and many early opportunities for commercial deployment. In this project, we are developing and testing a 10-kW advanced dish/Stirling system to address these applications. Our objective is to fabricate, demonstrate, and field a fully integrated, stand-alone water-pumping system for use at a Native American site in the southwest United States by early 2001.

System Description

In FY99, we successfully designed, built, and initiated testing of a 10-kW dish/Stirling system in a grid-connected mode at the National Solar Thermal Test Facility in Albuquerque. The system is based on Sun♦Lab-developed structural facets, the proven SOLO 161 kinematic Stirling engine, and concentrator and controls technology developed previously by the Cummins Engine Company. The Sun♦Lab-developed facets are low-cost, high-performance parabolic structures that use industry-proven laminating techniques. The reflective surface is thin glass for durability. The SOLO engine has been developed for cogenertion and solar markets and has a proven track record of hundreds of thousands of hours of operation. The receiver is currently the SOLO directly illuminated receiver, but will be replaced with a more efficient heat-pipe receiver in the near future. The controls system is the advanced control system developed through the Cummins program, modified for this system. The controls system is a complete solution, providing automated (unattended) control, fault detection, data acquisition, and communications.

WG Associates (WGA) of Dallas, Texas, provided the detailed system design, controls integration, and managed fabrication and installation of the first prototype in the summer of 1999. After initial checkout, the system had been operated for more than 350 hours by the end of 1999, meeting all performance objectives for power, efficiency, and automated operation. Some highlights of the system include:

- A period of less than one year from concept to hardware installation.
- A measured peak concentration ratio of more than 11,000 suns, with peak power generation of 9.5 kW_e.
- A self-learning tracking system that accounts for setup inaccuracies.
- Completion of 50-hour qualification testing and implementation of unattended automated startup and shutdown ahead of schedule.

The Remote Power System in operation at Sandia's National Solar Thermal Test Facility in Albuquerque.

Concentrating Solar Power Program

The SOLO 161 Stirling engine/receiver package.

The system has been operating in fully unattended mode since November 1999. Without operator intervention (or even on-site presence), it starts up each morning at dawn, operates throughout the day (responding to clouds and wind as needed), and shuts itself down at sunset. The system can be monitored and (if needed) controlled over the Internet.

Continuing Development

From the ongoing testing, we are already learning about ways to improve the system. We are currently working with WGA on design improvements to reduce structure size and weight, simplify installation, and operate in stand-alone mode (without a grid tie). We are also testing an advanced heat-pipe receiver for implementation on the system later this year. The heat pipe will improve efficiency, simplify the control system, and enhance durability and lifetime. We are also working with both the engine and dish partners to further improve the control systems.

The next-generation system will address issues raised on the first system, incorporate lessons learned, and enhance the system for remote operation, including:

- greatly simplified field installation and operation
- reduced cost
- simplified structure design
- better dish/engine size matching
- insulation/aperture/receiver redesign for durability
- reduced vibration and noise
- more complete controls integration

Native American Applications

The primary applications for the system are remote: water pumping, village electrification, etc. While many of those applications are in developing countries, we have identified remote water pumping as one interesting domestic opportunity, following a survey of Native American tribes in the southwest United States. We have initiated partnership discussions with four tribes (two each in Arizona and New Mexico) to install demonstration systems on their lands.

In FY00, we will establish a working relationship with one or more Native American application partners, including better understanding their potential applications (and the technical and cultural needs associated with those applications) and providing training for operators and maintenance personnel. Once off-grid operation and reliability have been demonstrated in late 2000, we will begin installation of one or more systems at selected Native American sites. We anticipate testing continuing over a multiyear period, with improvements being implemented as they are identified and developed.

International Markets

The major markets for these systems are international. As reliable remote operation is demonstrated over the next couple years, export opportunities for U.S. industry will be substantial. To maintain U.S. leadership in this area, we will transfer the technology to one or more major U.S. industry partners as systems suppliers. These suppliers will assume responsibility for planning and implementation of international manufacturing, marketing, sales, and support efforts.

Previous marketing studies by U.S. industry have estimated markets for this type of remote system to be as much as several billion dollars per year. Achieving that level of market penetration will, of course, require continued development, testing, and field validation to reduce costs, improve reliability and lifetime, and decrease maintenance requirements. The overall system concept, as well as our research and development programs, will continue to be targeted to meet these needs.

For on-line information about **Sun♦Lab,** please visit **http://www.eren.doe.gov/sunlab.** Information about the U.S. Department of Energy's Concentrating Solar Power Program can be found at **http://www.eren.doe.gov/csp.**

For more information on renewable energy or for additional copies of this brochure, contact the Energy Efficiency and Renewable Energy Clearinghouse (EREC): **1-800-DOE-EREC (363-3732).**

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